UNCLASSIFIED Change Topic: Technical Note 36

Change Topic: Technical Note 36

This change package accommodates the text changes to support the proposed solution (see table below) within the public Signals-in-Space (SiS) documents. All comments must be submitted in Comments Resolution Matrix (CRM) form.

The columns in the WAS/IS table following this page are defined below:

Section Number: This number indicates the location of the text change within the document.

(WAS) <Document Title>: Contains the baseline text of the impacted document.

Proposed Heading: Contains proposed changes to existing section titles and/or the titles to new sections

Proposed Text: Contains proposed changes to baseline text.

Rationale: Contains the supporting information to explain the reason for the proposed changes.

PROBLEM STATEMENT:

Current Signal in Space (SiS) documents reference an outdated coordinate conversion standard (Technical Note 21) between earth centered earth fixed (ECEF) and earth centered inertial (ECI).

SOLUTION: (Proposed)

Update GPS technical baseline documents to reflect the latest coordinate conversion standard between ECEF and ECI as documented in Technical Note 36.

Start of WAS/IS for IS-GPS-200E Changes

Section Number	Tech Note 36 Propose d Heading	IS-GPS-200 Rev E Navstar GPS	Space Segment/Navigation User Interfaces		Tech Note 36 Redlines	
2.1		Specifications			Specifications	
		Federal	None	_	Federal	None
		Military	None		Military	None
		Other Government Activity	None		Other Government Activity	None
		Standards			Standards	
		Federal	None		Federal	None
		Military	None		Military	None
		Other Publications			Other Publications	-
			GP-03-001 (GPS Interface Control Working Group Charter)			GP-03-001 (GPS Interface Cor
						International Earth Rotation and (IERS) Technical Note 36
30.3.3.5.1		earth orientation parameters. ECEF and ECI coordinate trans 20.3.3.4.3.3.2). The number o message type 32 are given in T (International Earth Rotation a	provides SV clock correction parameters (ref. Section 30.3 The EOP message provides users with parameters to cons formation (a simple transformation method is defined in S f bits, scale factors (LSBs), the range, and the units of all EC Fable 30-VII. The equations described in this section are ba and Reference Systems Service) IERS Technical Note 21. Ho ed to a new Technical Note in the next revision.	struct the ection DP fields of ased on	Message type 32, Figure 30-5, earth orientation parameters. ECEF and ECI coordinate trans 20.3.3.4.3.3.2). The number o message type 32 are given in T (International Earth Rotation a these equations will be update	The EOP message provides us formation (a simple transforma of bits, scale factors (LSBs), the Fable 30-VII. The equations de and Reference Systems Service

	Rationale
Control Working Group Charter)	Add reference to the latest coordinate conversion standard (TN36).
n and Reference Systems Service	
n parameters (ref. Section 30.3.3.2) and s users with parameters to construct the rmation method is defined in Section he range, and the units of all EOP fields of described in this section are based on vice) IERS Technical Note 21. However, in the next revision.	The GPS Directorate will only f provide description on information that is broadcaste d in the navigational message. It is not Directorate' s responsibilit y to show users on

Section Number	Tech Note 36 Propose d	IS-GPS-200 Rev E Navstar GPS Space Segment/Navigation User Interfaces	Tech Note 36 Redlines	Rationale
	Heading			
30.3.3.5.1.	Heading	The EOP fields in the message type 32 contain the EOP needed to construct the ECEF-to-ECI coordinate transformation. The user computes the ECEF position of the SV antenna phase center using the equations shown in Table 30-II. The coordinate transformation, for translating to the corresponding ECI SV antenna phase center position, is derived using the equations shown in Table 30-VIII. The coordinate systems are defined in Section 20.3.3.4.3.3	The EOP fields in the message type 32 contain the EOP <u>data</u> needed to construct the ECEF-to-ECI coordinate transformation. The user computes the ECEF position of the SV antenna phase center using the equations shown in Table 30-II The <u>full</u> coordinate transformation, for translating to the corresponding ECI SV antenna phase center position, <u>ismay derivedbe</u> <u>usingaccomplished in</u> accordance with the <u>computations detailed in Chapter 5 of IERS Technical Note 36: IERS Conventions (2010) and equations shownfor UT1, xp and yp as documented in Table 30-VIII. The coordinateFigure system5.1 areon definedpage in73 Sectionof 20that document depicts the computational Terrestrial Reference System).3 Ongoing WGS 84 re-adjustment at NGA and incorporating the 2010 IERS Conventions, are expected to bring Earth based coordinate agreement to within 2 cm.³. In the context of the Conventions via either the Celestial Intermediate Origin (CIO) based approach" or the "Equinox based approach".⁴. The EOP parameters for AUT1 are to be applied within the "Rotation to terrestrial system" process, and the parameters for xp and yp are applied in the "Rotation for polar motion" process.³. Users are advised that the broadcast message type 32 EOP parameters already account for zonal, diurnal and semidiurnal effects (described in Chapter 8 of the IERS Conventions (2010)), so these effects should not be further applied by the <u>user</u>.³</u>	how to utilize those information The GPS Directorate will only provide description on information that is broadcaste d in the navigational message. It is not Directorate' s responsibilit y to show users on
				how to utilize those information Details for the calculation of Inertial- to-Geodetic rotation matrix can be found in

Section Number	Tech Note 36 Propose d Heading	IS-GPS-200 Rev E Navstar GPS Space Segment/Navigation User Interfaces	Tech Note 36 Redlines	Rationale
30.3.3.5.1. 1	Heading	An ECI position, R _{eci} , is related to an ECEF position, R _{ecef} , by a series of rotation matrices as following: R _{ecef} = [A][B][C][D] R _{eci} where the rotation matrices, A, B, C, and D, represent the effects of Polar Motion, Earth Rotation, Nutation and Precession, respectively. The message type 32 specifies the EOP parameters used in the construction of the Polar Motion, A, and Earth Rotation, B, matrices. The rotation matrices, A, B, C and D are specified in terms of elementary rotation matrices, R _i (α), where α is a positive rotation about the i th -axis ordinate, as follows: $ \begin{bmatrix} 1 & 0 & 0 \\ 0 & cos(\alpha) & sin(\alpha) \\ 0 & -sin(\alpha) & cos(\alpha) \end{bmatrix}, R_2(\alpha) = \begin{bmatrix} cos(\alpha) & 0 & -sin(\alpha) \\ sin(\alpha) & 0 & cos(\alpha) \end{bmatrix} $ $ R_3(\alpha) = \begin{bmatrix} cos(\alpha) & sin(\alpha) & 0 \\ -sin(\alpha) & cos(\alpha) & 0 \\ 0 & 0 & 1 \end{bmatrix} $	An ECI position, Reci , is related to an ECEF position, Recef , by a series of rotation matrices as following: The relevant computations utilize elementary rotation matrices Ri(α), where α is a positive rotation about the ith-axis ordinate, as follows: R _{eset} = [A][B][C][D] R _{ee} where the rotation matrices, A, B, C, and D, represent the effects of Polar Motion, Earth Rotation, Nutation and Precession, respectively. The message type 32 specifies the EOP parameters used in the construction of the Polar Motion, A, and Earth Rotation, B, matrices. The rotation matrices, A, B, C and D are specified in terms of elementary rotation matrices, R(α), where α is a positive rotation about the i th -axis ordinate, as follows: R ₁ (α) = $\begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos(\alpha) & \sin(\alpha) \\ 0 & -\sin(\alpha) & \cos(\alpha) \end{bmatrix}$, R ₂ (α) = $\begin{bmatrix} \cos(\alpha) & 0 & -\sin(\alpha) \\ 0 & 1 & 0 \\ \sin(\alpha) & 0 & \cos(\alpha) \end{bmatrix}$ R ₃ (α) = $\begin{bmatrix} \cos(\alpha) & \sin(\alpha) & 0 \\ -\sin(\alpha) & \cos(\alpha) & 0 \\ 0 & 0 & 1 \end{bmatrix}$	IERS TN36. The GPS Directorate will only provide description on information that is broadcaste d in the navigational message. It is not Directorate' s responsibilit y to show users on how to utilize that information Details for the calculation of Inertial-
30.3.3.5.1.		The user shall compute the Inertial-to-Geodetic rotation matrix, ABCD using the equations shown in	The user shall compute the Inertial-to-Geodetic rotation matrix, ABCDshall using be calculated in accordance with the computations detailed in Chapter 5 of IERS Technical Note 36: IERS	to-Geodetic rotation matrix can be found in IERS TN36. The GPS Directorate

Section Tech Number Note Propo d Headi	se	Tech Note 36 Redlines	Rationale
	Table 30-VIII.	Conventions (2010) and equations shownfor UT1, xp and yp as documented in Table 30-VIII.	 will only provide description on information that is broadcaste d in the navigational message. It is not Directorate' s responsibilit y to show users on how to utilize those information . Details for the calculation of Inertial- to-Geodetic rotation matrix can be found in IERS TN36.

Section Number	Tech Note 36 Propose	IS-GPS-200 Rev E Navstar GPS Space Segment/Navigation User Interfaces		Tech Note 36 Redlines
	d Heading			
30.3.3.5.1.		Table 30-VIII. Application of	EOP Parameters (Part 1 of 2)	< <u>DELETE></u>
1		Element/Equation	Description	
		$TDT = t + 51 \cdot 184$	Compute Terrestrial Dynamical Time relative to GPS Time t	
		J.E.D. = TDT expressed in days of 86400 sec	Compute Julian Ephemeris Date	
		$g = \frac{\pi}{180^{\circ}} \left[357.528 + 35999.05 \frac{\text{J.E.D.} - 2451545}{36525} \right]$	Compute Mean Anomaly of Earth in its orbit, g	
		$JB.D. = JE.D. + \frac{0.001658 \sin(g + 0.0167 \sin g)}{86400 s}$	Compute Julian Date in Barycentric Dynamical Time	
		$T = \frac{J.B.D 2451545}{36525}$	Compute time from J2000 Julian Epoch in Julian Centuries	
		$\zeta = 2306.2181 \text{ T} + 0.30188 \text{ T}^{2} + 0.017998 \text{ T}^{3}$ $z = 2306.2181 \text{ T} + 1.09468 \text{ T}^{2} + 0.018203 \text{ T}^{3}$ $\theta = 2004.3109 \text{ T} - 0.42665 \text{ T}^{2} - 0.041833 \text{ T}^{3}$	Compute Precession Fundamental Angles at time t	
		$D = R_3 \left(-90^{\circ} - z\right) R_1(\theta) R_3 \left(90^{\circ} - \zeta\right)$ $\overline{\epsilon} = 23^{\circ} 26' 21''.448 - 46''.815 T - 0''.00059 T^2$	Calculate Precession Matrix at time, t	
		$\overline{\epsilon} = 23^{\circ}26'21''.448 - 46''.815T - 0''.00059T^2 + 0''.001813T^3$	Compute Mean Obliquity, $\overline{\epsilon}$, at time t	
		$C = R_{1} \left(-(\overline{\epsilon} + \Delta \epsilon) \right) R_{3} \left(-\Delta \psi \right) R_{1} \left(\overline{\epsilon} \right)$	Compute Nutation Matrix at time, t	
			·	

 Rationale
The GPS
Directorate
will only
provide
description
on
information
that is
broadcaste
d in the
navigational
message. It
is not
Directorate'
S
responsibilit
y to show
users on
how to
utilize those
information
Details for
the
calculation
of Inertial-
to-Geodetic
rotation
matrix can
be found in
IERS TN36.

Section Number	Tech Note 36 Propose	IS-GPS-200 Rev E Navstar GPS Space Segment/I	Navigation User Interfaces	Tech Note 36 Redlines	Rationale
	d Heading				
30.3.3.5.1.		Table 30-VIII. Application of E		Table 30-VIII. Application of EOP Parameters	The GPS
1		Element/Equation $\Delta \psi = \sum_{i=1}^{106} a_i \sin \left(\sum_{j=1}^5 e_j E_j \right)^{\dagger\dagger}$	Description Nutation in Longitude	Element/EquationDescription $UT1 = UTC + \Delta UT1 + \Delta UT1 (t - t_{EOP})$ Compute Universal Time at time t $x_p = PM _ X + PM \stackrel{\bullet}{X} (t - t_{EOP})$ Polar Motion in the x-axis	Directorate will only provide description
		$\Delta \psi = \sum_{i=1}^{106} a_i \sin\left(\sum_{j=1}^5 e_j E_j\right) $ ^{††} $\Delta \varepsilon = \sum_{i=1}^{64} b_i \cos\left(\sum_{j=1}^5 e_j E_j\right) $ ^{††}	Nutation in Obliquity	$y_{p} = PM _ Y + PM \stackrel{\bullet}{Y} (t - t_{EOP})$ Polar Motion in the y-axis	on information that is
		$\mathbf{UT1} = \mathbf{UTC} + \Delta \mathbf{UT1} + \Delta \mathbf{UT1} (t - t_{EOP})$	Compute Universal Time at time t	t is GPS system time at time of transmission, i.e., GPS time corrected for transit time (range/speed of light).	broadcaste d in the navigational
		$T_{U} = \frac{J.D 2451545}{36525}$ where J.D. = UT1 expressed in days of 86400 sec	Compute Universal Time from J2000 Julian Epoch in Julian Centuries		message. It is not Directorate'
		$\bar{\alpha} = \frac{2\pi}{24^{h}} \begin{pmatrix} UT1 + 6^{h} 41^{m} 50^{s} 54841 \\ + 8640184^{s} 812866T_{U} \\ + 0^{s} 093104T_{U}^{2} - 6^{s} 2 \times 10^{-6}T_{U}^{3} \end{pmatrix}$ $\alpha = \bar{\alpha} + \Delta \psi \cos(\bar{\epsilon} + \Delta \epsilon)$	Compute Mean Greenwich Hour Angle		s responsibilit y to show users on how to
		$\alpha = \overline{\alpha} + \Delta \psi \cos(\overline{\epsilon} + \Delta \epsilon)$	Compute True Greenwich Hour Angle		utilize that information
		$B=R_{3}\left(\alpha\right)$	Compute Rotation Matrix at time, t		
		$A = R_2 (-x_p) R_1 (-y_p)$ where $x_p = PM_X + PM_X (t - t_{EOP})$ $y_p = PM_Y + PM_Y (t - t_{EOP})$	Compute Polar Motion Matrix at time, t		Details for the calculation
		ABCD = [A][B][C][D]	Compute Inertial-to-Geodetic Rotation matrix, ABCD		of Inertial- to-Geodetic rotation
		 t is GPS system time at time of transmission, i.e., GPS ti The Nutation in Longitude and the Nutation in Obliquity pp. S23-S26, evaluated at time T. 			matrix can be found in IERS TN36.
					Updated the equations

Section	Tech	IS-GPS-200 Rev E Navstar GPS Space Segment/Navigation User Interfaces	Tech Note 36 Redlines
Number	Note 36		
	Propose		
	d		
	Heading		
	Incoding		
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End of WAS/IS for IS-GPS-200E

Rationale
for xp and yp to ensure that the derivatives are applied to the second term "PM_X (t-tEOP)" and "PM_Y (t-tEOP)" so that the units work out correctly.
Updated the equation UT1 to ensure that the derivative is applied to the third term "deltaUT1 (t-tEOP)" and so that the units work out correctly.

Start of WAS/IS for IS-GPS-705A Changes

Section Number	Tech Note 36 Proposed Heading	IS-GPS-705 Rev A L5 SS and Nav User Segment Interfaces	Tech Note 36 Redlines	Rationale	
2.2		Other Publications None	Other Publications —None International Earth Rotation and Reference Systems Service (IERS) Technical Note 36	Add reference to the latest coordinate conversion standard (TN36).	
20.3.3.5.1		The EOP fields in the message type 32 contain the EOP needed to construct the ECEF-to-ECI coordinate transformation. The user computes the ECEF position of the SV antenna phase center using the equations shown in Table 20-II. The coordinate transformation, for translating to the corresponding ECI SV antenna phase center position, is derived using the equations shown in Table 20-VIII. The coordinate systems are defined in Section 20.3.3.4.3.3 of IS-GPS-200. The equations described in this section are based on (International Earth Rotation and Reference Systems Service) IERS Technical Note 21. However, these equations will be updated to a new Technical Note in revision TBD.	The EOP fields in the message type 32 contain the EOP needed to construct the ECEF to ECI coordinate transformation. The user computes the ECEF position of the SV antenna phase center using the equations shown in Table 20-II. The coordinate transformation, for translating to the corresponding ECI SV antenna phase center position, is derived using the equations shown in Table 20-VIII. The coordinate systems are defined in Section 20.3.3.4.3.3 of IS-GPS-200. The equations described in this section are based on (International Earth Rotation and Reference Systems Service) IERS Technical Note 21. However, these equations will be updated to a new Technical Note in revision TBD. <delete></delete>	Contents of IS705-319 is now merged as a part of IS705-320.	
20.3.3.5.1			An ECI position, R _{eci} , is related to an ECEF position, R _{ecef} , by a series of rotation matrices as following:	An ECI position, Reci, is related to an ECEF position, Recef, by a series of rotation matrices as following:	The GPS Directorate
		R _{ecef} = [A][B][C][D]R _{eci} ,		will only provide description on	
		where the rotation matrices, A, B, C, and D, represent the effects of Polar Motion, Earth Rotation, Nutation and	where the rotation matrices, A, B, C, and D, represent the effects of Polar Motion, Earth Rotation, Nutation and	information that is broadcasted	
		Precession, respectively. The message type 32 specifies the EOP parameters used in the construction of the Polar Motion, A, and Earth Rotation, B, matrices.	Precession, respectively. The message type 32 specifies the EOP parameters used in the construction of the Polar Motion, A, and Earth Rotation, B, matrices.	in the navigational	
		The rotation matrices, A, B, C and D are specified in terms of elementary rotation matrices $R_i(\alpha)$, where α is a positive rotation about the i th - axis ordinate, as follows:	 The rotation matrices, A, B, C and D are specified in terms of elementary rotation matrices Ri(ℤ), where ℤ is a positive rotation about the ith - axis ordinate, as follows: The EOP fields in the message type 32 contain the EOP data needed to construct the ECEF-to-ECI coordinate transformation. The user computes the ECEF position of the SV antenna phase center using the equations shown in Table 20-II. The full coordinate transformation for translating to the corresponding ECI SV antenna phase center position may be accomplished in accordance with the 	message. It is not Directorate's responsibility to show users on how to utilize those	

Section Number	Tech Note 36 Proposed Heading	IS-GPS-705 Rev A L5 SS and Nav User Segment Interfaces	Tech Note 36 Redlines	Rationale
		$ R_{1}(\alpha) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos(\alpha) & \sin(\alpha) \\ 0 & -\sin(\alpha) & \cos(\alpha) \end{bmatrix} , \ R_{2}(\alpha) = \begin{bmatrix} \cos(\alpha) & 0 & -\sin(\alpha) \\ 0 & 1 & 0 \\ \sin(\alpha) & 0 & \cos(\alpha) \end{bmatrix} $ $ R_{3}(\alpha) = \begin{bmatrix} \cos(\alpha) & \sin(\alpha) & 0 \\ -\sin(\alpha) & \cos(\alpha) & 0 \\ 0 & 0 & 1 \end{bmatrix} $	$\begin{aligned} & \text{computations detailed in Chapter S of IERS Technical Note 36: IERS Conventions (2010) and equations for UT1, xp and yp as documented in Table 20-VIII. Figure 5.1 on page 73 of that document depicts the computational flow starting from GCRS (Geocentric Celestial Reference System) to ITRS (International Terrestrial Reference System). Ongoing WGS 84 re-adjustment at NGA and incorporating the 2010 IERS Conventions, are expected to bring Earth based coordinate agreement to within 2 cm. In the context of the Conventions, the user may as a matter of convenience choose to implement the transformation computations via either the Celestial Intermediate Origin (CIO) based approach" or the "Equinox based approach". The EOP parameters for AUT1 are to be applied within the "Rotation to terrestrial system" process, and the parameters for xp and yp are applied in the "Rotation for polar motion" process. Users are advised that the broadcast message type 32 EOP parameters already account for zonal, diurnal and semidiurnal effects (described in Chapter 8 of the IERS Conventions (2010)), so these effects should not be further applied by the user. The relevant computations utilize elementary rotation matrices Ri(\alpha), where \alpha is a positive rotation about the ith-axis ordinate, as follows: R_1(\alpha) = \begin{bmatrix} \cos(\alpha) & \sin(\alpha) \\ 0 & -\sin(\alpha) & \cos(\alpha) \end{bmatrix}, R_2(\alpha) = \begin{bmatrix} \cos(\alpha) & 0 & -\sin(\alpha) \\ 0 & 1 & 0 \\ \sin(\alpha) & 0 & \cos(\alpha) \end{bmatrix}$	information.
20.3.3.5.1		The user shall compute the Inertial-to-Geodetic rotation matrix, ABCD using the equations shown in Table 20-VIII.	The user shall compute the Inertial-to-Geodetic rotation matrix, ABCDshall usingbe calculated in accordance with the computations detailed in Chapter 5 of IERS Technical Note 36: IERS Conventions (2010) and equations shownfor UT1, xp and yp as documented in Table 20-VIII.	The GPS Directorate will only provide description on information that is broadcasted in the

Section Number	Tech Note 36 Proposed Heading	IS-GPS-705 Rev A L5 SS and Nav User Segment Interfaces	Tech Note 36 Redlines

Rationale
navigational
message. It
is not
Directorate's
responsibility
to show
users on how
to utilize
those
information.
Details for
the
calculation
of Inertial-
to-Geodetic
rotation
matrix can
be found in
IERS TN36.

	Proposed Heading				
20.3.3.5.1					
		Table 20-VIII. Application of EOP Parameters (Part 1 of 2)		< <u>DELETE></u>	The GPS
		Element/Equation	Description		Directorate will only
		TDT=t+51 ^S 184	Compute Terrestrial Dynamical Time relative to GPS		provide
			Time t		description
					on
		J.E.D. = TDT expressed in days of 86400 sec	Compute Julian Ephemeris Date		information
					that is
		$g = \frac{\pi}{180^{\circ}} \left[357.528 + 35999.05 \frac{\text{JED} - 2451545}{36525} \right]$	Compute Mean Anomaly of Earth in its orbit, g		broadcasted
			compactive and a many of Later in its order, g		in the navigational
					message. It
		0 ⁵ 001658sin(g+0.0167sin g)	Commite Julian Date in Demonstric Demonical T		is not
		$J.B.D. = J.E.D. + \frac{0.0010000311(g + 0.010731111g)}{86400s}$	Compute Julian Date in Barycentric Dynamical Time		Directorate's
					responsibility
		$T = \frac{J.B.D 2451545}{36525}$ Compute time from J2000 Julian Epoch in Julian Centuries			to show
				users on how to utilize	
			Chunes		those
					information.
		$\zeta = 2306'.2181 \text{ T} + 0'.30188 \text{ T}^2 + 0'.017998 \text{T}^3$ z = 2306'.2181 T + 1''.09468 T ² + 0'.018203 T ³			
		$z = 2306.2181 \text{ T} + 1.09468 \text{ T}^2 + 0.018203 \text{ T}^3$	Compute Precession Fundamental Angles at time t		
		$\theta = 2004$. 3109 T - 0. 42665 T ² - 0. 041833 T ³			
		$D = R_3 \left(-90^{\circ} - z\right) R_1(\theta) R_3 \left(90^{\circ} - \zeta\right)$	Calculate Precession Matrix at time, t		
		$\overline{\epsilon} = 23^{\circ}26'21''.448 - 46''.815T - 0''.00059T^2$	Compute Mean Obliquity, $\overline{\epsilon}$, at time t		
		+ 0001813T ³			
		$C = B \left(\sqrt{s} + \Delta s \right) B \left(-\Delta u d \right) B \left(\overline{s} \right)$ Compute Nutation Matrix at time, t	Compute Nutation Matrix at time t		
		$C = R_{1} \left(-(\overline{\epsilon} + \Delta \epsilon) \right) R_{3} \left(-\Delta \psi \right) R_{1} \left(\overline{\epsilon} \right)$			
		<u> </u>	1		
					12

Section Number	Tech Note 36 Proposed Heading	IS-GPS-705 Rev A L5 SS and Nav User Segment In	nterfaces	Tech Note 36 Redlines		Rationale
20.3.3.5.1		Table 20-VIII. Application of EOP Parameters (Part 2 of 2)		Table 20-VIII. Application of EOP Parameters		The GPS Directorate
		Element/Equation	Description	Element/Equation	Description	will only
		$\Delta \Psi = \sum_{i=1}^{106} a_i \sin\left(\sum_{j=1}^5 e_j E_j\right) $ ^{††} $\Delta \mathcal{E} = \sum_{i=1}^{64} b_i \cos\left(\sum_{j=1}^5 e_j E_j\right) $ ^{††}	Nutation in Longitude Nutation in Obliquity	$UT1 = UTC + \Delta UT1 + \Delta UT1 (t - t_{EOP})$ $x_p = PM _ X + PM \stackrel{\bullet}{X} (t - t_{EOP})$ $y_p = PM _ Y + PM \stackrel{\bullet}{Y} (t - t_{EOP})$	Compute Universal Time at time t Polar Motion in the x-axis Polar Motion in the y-axis	provide description on information that is broadcasted
		$\Delta \mathcal{E} = \sum_{i=1}^{D} b_i \cos \left(\sum_{j=1}^{P} e_j E_j \right)^{\text{T}}$ \bullet \bullet $UT1 = UTC + \Delta UT1 + \Delta UT1(t - t_{EOP})$	Compute Universal Time at time t		e., GPS time corrected for transit time (range/speed of light).	in the navigational message. It is not Directorate's
		$T_{U} = \frac{JD 2451545}{36525}$ where J.D. = UT1 expressed in days of 86400 sec	Compute Universal Time from J2000 Julian Epoch in Julian Centuries			responsibility to show users on how to utilize those
		$\bar{\alpha} = \frac{2\pi}{24^{h}} \begin{pmatrix} UT1 + 6^{h}41^{m}50^{s}.54841 \\ + 8640184^{s}.812866T_{U} \\ + 0^{s}.093104T_{U}^{2} - 6^{s}.2 \times 10^{-6}T_{U}^{3} \end{pmatrix}$	Compute Mean Greenwich Hour Angle			information.
		$\alpha = \overline{\alpha} + \Delta \psi \cos(\overline{\epsilon} + \Delta \varepsilon)$ $B = B_3(\alpha)$	Compute True Greenwich Hour Angle Compute Rotation Matrix at time, t			
		$A = R_2 (-x_p) R_1 (-y_p)$ where $x_p = PM_X + PM_X (t - t_{EOP})$ $y_p = PM_Y + PM_Y (t - t_{EOP})$	Compute Polar Motion Matrix at time, t			
		$y_{p} = PM_Y + PM_Y (t - t_{EOP})$ $ABCD = [A][B][C][D]$	Compute Inertial-to-Geodetic Rotation matrix, ABCD			
			S time corrected for transit time (range/speed of light). bliquity are as described in The Astronomical Almanac			13

End of WAS/IS for IS-GPS-705A

Start of WAS/IS for IS-GPS-800A Changes

Section	Tech Note 36 Proposed	IS-GPS-800 Rev A Navstar GPS Space Segment/User Segment L1C Interface	Tech Note 36 Redlines	Rationale
Number	Heading			
2.2			IERS Technical Note 36 International Earth Rotation and Reference System Technical Note 36 System Technical Note 36	ECEF-ECI conversion details can be found in IERS TN36.
			System Technical Note 36	Touriu în IERS TN30.
3.5.4.2.3		The EOP fields in subframe 3, page 2 contain the EOP needed to construct the	The EOP fields in subframe 3, page 2 contain the EOP needed to construct	ECEF-ECI conversion details can be
		ECEF-to-ECI coordinate transformation. The user computes the ECEF position of	the ECEF-to-ECI coordinate transformation. The user computes the ECEF	found in IERS TN36.
		the SV antenna phase center using the equations shown in Table 3.5-2. The	position of the SV antenna phase center using the equations shown in Table	
		coordinate transformation, for translating to the corresponding ECI SV antenna	3.5-2. The coordinate transformation, for translating to the corresponding	
		phase center position, is derived using the equations shown in Section	ECI SV antenna phase center position, is derived using the equations shown	
		30.3.3.5.1.1 and Table 30-VIII of IS-GPS-200. The coordinate systems are defined	in Section IERS 30.3.3.5.1.1 Technical Note 36 and Table 30-VIII of IS-GPS-200.	
		in Section 20.3.3.4.3.3 of IS-GPS-200.	The coordinate systems are defined in Section 20.3.3.4.3.3 of IS-GPS-200.	

End of WAS/IS for IS-GPS-800A